

## Fish Facts September 2022 – Bonefish on drugs

Packaged within a pleasant tropical sand flat environment, the supreme camouflage, flighty disposition, selective feeding and blistering speed of bonefish make them the complete light tackle sportfish. Not good eating though, so bonefish are a catch and release option for anglers, and seldom targeted by commercial interests. That their populations could be threatened seems unthinkable. But a recent study in the Florida Keys has found bonefish there are threatened by pharmaceutical contaminants. As one of my aquatic veterinarian colleagues said recently, “*It is utter folly to think that we can just flush our wastes away without impact*”.

As their name implies, bonefish are full of bones, thus why they are not the best eating. Despite this, economic analysis of the sportfishery targeting Atlantic bonefish (*Albula vulpes*) in the Florida Keys has found this species alone generates over 1 billion dollars per year to the Florida economy, from a fish population estimated as a mere 300,000 fish! This amounts to a value of around \$3500 per fish, per annum. But since bonefish live for up to 20 years, this means each individual fish is worth around \$70,000 to the Florida economy over its lifetime. At an average size of 2-3 kg, that means these fish are worth between \$25 K and \$35,000 per kg, which at the top end of that scale is approaching "worth its weight in gold" status.

However, despite their high value, tight management, catch and release, and sustained efforts by angling groups to protect and restore bonefish nursery habitats over several decades, researchers from the Bonefish and Tarpon Trust (BTT) and FIU (Florida International University) have become extremely concerned that populations of bonefish in south Florida continue to decline. This has been especially so over the past decade, raising questions that stimulated a study starting in 2018 to examine what other factors are at play, targeting water pollutants.

After 4 years study, the results recently published by FIU and BTT reveal some very worrying information. They found that every one of the 93 bonefish examined had pharmaceuticals in their bloodstream. Even worse, close to 60% of bonefish had pharmaceutical levels that exceeded a third of the human therapeutic blood plasma threshold, and thus were undoubtedly high enough to cause clinical effects in exposed fish. Further, all of the fish except one had cocktails of pharmaceuticals in their bloodstream, which can be expected to result in mixture interactions and poorly understood health effects.

One of the most contaminated fish from the Lakes Passage area near Key West had in its blood:

- 3 heart medications (with concentrations up to 10 times the human therapeutic level);
- 1 Parkinson’s disease medication (at 30 times the therapeutic concentration);
- 8 antidepressants (at levels 10 – 300 (!) times above the human therapeutic level);
- An antihistamine, and antifungal and stomach medications;
- and the opioid Codeine.

The origin of the pharmaceuticals is undoubtedly from sewage wastewater disposed into coastal waterways, but the pharmaceuticals were found to be ubiquitous in bonefish throughout all of South Florida, both near and far (up to 70 miles /115 km) from mainland population centers. Every prey item (crabs, shrimp and small fish) examined also hosted a similar pharmaceutical cocktail, indicating that bonefish were being exposed not only directly via the water, but also through their food chain. The contamination of the food chain indicates that bonefish are not a special case of high vulnerability to pharmaceutical pollution, but instead implies certain exposure of all other fish and invertebrate species that rely on seagrass beds and sandflats.

Lead researcher Associate Professor Jennifer Rehage from FIU stated “*These findings are truly alarming. Pharmaceuticals are an invisible threat, unlike algal blooms or turbid waters. Yet these results tell us that they are a formidable threat to our fisheries, and highlight the pressing need to address our longstanding wastewater infrastructure issues.*”

This study was undertaken because traditional fisheries management and habitat restoration efforts were not halting the decline of bonefish in the Florida Keys. But unfortunately for those of us who work in the field of aquatic animal health, this news is not new. A landmark study published in 2007 found that exposure of fathead minnow (*Pimephales promelas*) to environmental concentrations of synthetic estrogens used in birth control pills resulted in complete collapse and extinction of the fish population within 3 years in a whole-of-lake scale experiment conducted in Canada. "The pill" had simply feminised most of the male fish, causing recruitment failure. Another study published in 2009 found that household detergents at environmental concentrations affected moulting, feeding and the endocrine system of Maine lobsters on the US east coast. In 2013, a study of redbfin perch (*Perca fluviatilis*) exposed to the antidepressant oxazepam (benzodiazepine, or happy pills) via the water showed that the drug increased swimming activity and feeding rates at extremely dilute concentrations commonly measured in the environment in Sweden. Another study published in 2015 on Atlantic croakers (*Micropogonias undulatus*, a smaller relative of our mulloway) in Texas found their swimming performance and fin reflexes were significantly impaired after exposure to environmental concentrations of the antibacterial hand cleaner triclosan via food items.

The list of similar studies goes on and on, but by now the message is clear. Dilution can no longer be considered an acceptable solution to pollution. The researchers at BTT and FIU tasked with studying and managing fish which are literally worth their weight in gold, were quick to highlight “*the urgent need to upgrade sewage wastewater infrastructure in Florida*”, and demanded that “*wastewater is brought to the forefront of water quality issues*”. But these issues occur everywhere, including Australia. With the noise from animal rights groups amplifying daily with farcical demands for bans on catch and release fishing based on alleged fish welfare grounds, where are their voices when confronted with the true nature of a real welfare issue for wild aquatic animals? In reality, the equation is simple: Lose habitat or water quality = lose fish = no fish welfare. Of course, anyone with basic maths skills will also realise that the No habitat/ water quality = no fish welfare, equation can also be expressed as:

Habitat and water quality = fish welfare.

So lets get cracking on dealing with the real fish welfare issues which, not coincidentally, will also lead to more fish. Better habitat = better fishing. Anyone heard that before ?

For more info on the BTT/FIU study, see:

<https://news.fiu.edu/2022/pharmaceutical-contaminants-discovered-in-south-florida-bonefish>

<https://hakaimagazine.com/features/the-search-for-whats-harming-floridas-beloved-bonefish/>